

REPPERGER RESEARCH INTERN PROGRAM

RESEARCH PROJECT #: AFRL-RHD-23-02

Advancing Microscopy to Directly Visualize Directed Energy Interactions with Cells

PROJECT DESCRIPTION: Directly visualizing directed energy (DE) interactions with tissues and cells can be quite challenging, particularly for short electromagnetic or optical exposures with durations shorter than one microsecond. Many optical based techniques can provide high resolution imagery of the interactions, but lack in temporal resolution when tasked with visualizing the dynamics occurring during an exposure. This is primarily due to limitations on image sensor read rates, and the need for longer integration times to collect sufficient signal to accurately resolve a response. My research group is focused on developing advanced microscopy and spectroscopy techniques to understand the fundamental mechanisms of directed energy interactions. Among the current research interests include ultrafast imaging systems to directly study laser-tissue interaction or pulsed electric field excitation of cellular membranes, and Raman or Brillouin spectroscopy for studying chemical and mechanical changes in response to stimulation. This project will provide the opportunity to utilize novel ultrafast imaging systems to study mechanisms of DE interaction or injury on in vitro samples. Interns for this topic will have the opportunity to gain experience with these systems and help develop novel methods for elucidating mechanisms of optical or radiofrequency stimulation of cells and tissues. The skills gained will include microscopy, imaging processing, cell culture expertise, ultrafast imaging technologies, and optical system design.

ACADEMIC LEVEL: Master's, PhD

DISCIPLINE NEEDED:

- Biomedical Engineering
- Physics
- Biology

RESEARCH LOCATION: JBSA-Fort Sam Houston, San Antonio, Texas

RESEARCH MENTOR: Joel N. Bixler, PhD
Biomedical Engineering Texas A&M University, 2015



Joel Bixler is a Research Biomedical Engineer in the Bioeffects Division at the Air Force Research Laboratory, Airman Systems Directorate. He joined AFRL in 2014 as a Pathways student, and currently serves as a principal investigator on project studying laser tissue interactions using ultrafast imaging systems. This includes efforts to visualize tissue optical properties and an AFOSR funded grant developing novel imaging tools to study pulsed laser ablation. Dr. Bixler's research group also focuses on developing machine learning based image processing tools and compressed optical sensing-based methods for visualizing bioelectromagnetics. Dr. Bixler has authored over 25 peer-reviewed publications and is a leader within the SPIE international society for optics and photonics. *Photo courtesy of the U.S. Air Force Research Laboratory.*